What is claimed is:

1. A method for producing a semiconductor-on-insulator structure comprising:

(A) providing first and second substrates wherein:

(1) the first substrate comprises a first external surface for bonding to the second substrate (the first bonding surface), a second external surface for applying force to the first substrate (the first force-applying surface), and an internal zone for separating the first substrate into a first part and a second part (the separation zone), wherein:

(a) the first bonding surface, the first force-applying surface, and the separation zone are substantially parallel to one another;

(b) the second part is between the separation zone and the first bonding surface; and

(c) the first substrate comprises a substantially single-crystal semiconductor material; and

(2) the second substrate comprises two external surfaces, one for bonding to the first substrate (the second bonding surface) and another for applying force to the second substrate (the second force-applying surface), wherein:

(a) the second bonding surface and the second force-applying surface are substantially parallel to one another and are separated from one another by a distance $D_2$; and

(b) the second substrate comprises an oxide glass or an oxide glass-ceramic;

(B) bringing the first and second bonding surfaces into contact;

(C) for a period of time sufficient for the first and second substrates to bond to one another at the first and second bonding surfaces, simultaneously:

(1) applying force to the first and second force-applying surfaces to press the first and second bonding surfaces together;

(2) subjecting the first and second substrates to an electric field which is characterized by first and second voltages $V_1$ and $V_2$ at the first and second force-applying surfaces, respectively, said voltages being uniform at those surfaces with $V_1$ being higher than $V_2$ so that the

electric field is directed from the first substrate to the second substrate; and

(3) heating the first and second substrates, said heating being characterized by first and second temperatures $T_1$ and $T_2$ at the first and second force-applying surfaces, respectively, said temperatures being uniform at those surfaces and being selected so that upon cooling to a common temperature, the first and second substrates undergo differential contraction to thereby weaken the first substrate at the separation zone; and

(D) cooling the bonded first and second substrates and separating the first and second parts at the separation zone;

wherein the oxide glass or oxide glass-ceramic comprises positive ions which during step (C), move within the second substrate in a direction away from the second bonding surface and towards the second force-applying surface.

2. A method for producing a semiconductor-on-insulator structure comprising:

(A) providing first and second substrates wherein:

(1) the first substrate comprises a first external surface for bonding to the second substrate (the first bonding surface), a second external surface for applying force to the first substrate (the first force-applying surface), and an internal zone for separating the first substrate into a first part and a second part (the separation zone), wherein:

(a) the first bonding surface, the first force-applying surface, and the separation zone are substantially parallel to one another;

(b) the second part is between the separation zone and the first bonding surface; and

(c) the first substrate comprises a substantially single-crystal semiconductor material; and

(2) the second substrate comprises two external surfaces, one for bonding to the first substrate (the second bonding surface) and another for applying force to the second substrate (the second force-applying surface), wherein:

(a) the second bonding surface and the second force-applying surface are substantially parallel to one another and are separated from one another by a distance $D_2$; and

(b) the second substrate comprises an oxide glass or an oxide glass-ceramic;

(B) bringing the first and second bonding surfaces into contact;

(C) for a period of time sufficient for the first and second substrates to bond to one another at the first and second bonding surfaces, simultaneously:

(1) applying force to the first and second force-applying surfaces to press the first and second bonding surfaces together;

(2) subjecting the first and second substrates to an electric field which is characterized by first and second voltages $V_1$ and $V_2$ at the first and second force-applying surfaces, respectively, said voltages being uniform at those surfaces with $V_1$ being higher than $V_2$ so that the

electric field is directed from the first substrate to the second substrate; and

(3) heating the first and second substrates, said heating being characterized by first and second temperatures $T_1$ and $T_2$ at the first and second force-applying surfaces, respectively, said temperatures being uniform at those surfaces and being selected so that upon cooling to a common temperature, the first and second substrates undergo differential contraction to thereby weaken the first substrate at the separation zone; and

(D) cooling the bonded first and second substrates and separating the first and second parts at the separation zone;

wherein the oxide glass or oxide glass-ceramic comprises (a) non-bridging oxygens and (b) positive ions which during step (C), move within the second substrate in a direction away from the second bonding surface and towards the second force-applying surface.

3. The method of Claim 1 or 2 wherein the oxide glass or oxide glass-ceramic of the second substrate has a 0-300°C coefficient of thermal expansion CTE and a 250°C resistivity ρ which satisfy the relationships:

$5\text{x}10^{-7}/°\text{C} \leq \text{CTE} \leq 75\text{x}10^{-7}/°\text{C}$, and

$\rho \leq 10^{16}\ \Omega\text{-cm}$.

4. The method of Claim 1 or 2 wherein during step (C), the first and second substrates, at least in part, bond to one another through the reaction of the semiconductor material of the first substrate with oxygen originating from the second substrate.

5. The method of Claim 4 wherein the reaction of the semiconductor material of the first substrate with oxygen originating from the second substrate produces a region (the hybrid region) of enhanced oxygen concentration which begins at the first bonding surface and extends towards the separation zone.

6. The method of Claim 5 where the hybrid region has a thickness $\delta_H$ which satisfies the relationship:

$\delta_H \leq 200$ nanometers,

where $\delta_H$ is the distance between the first bonding surface and a surface which 1) is within the second part, 2) is substantially parallel to the first bonding surface, and 3) is the surface farthest from the first bonding surface for which the following relationship is satisfied:

$$C_O(x) - C_{O/Ref} \geq 50 \text{ percent}, \quad 0 \leq x \leq \delta_H,$$

where:

$C_O(x)$ is the concentration of oxygen as a function of distance x from the first bonding surface,

$C_{O/Ref}$ is the concentration of oxygen at a reference surface which 1) is within the second part, 2) is substantially parallel to the first bonding surface, and 3) is separated from that bonding surface by a distance $D_S/2$, where $D_S$ is the distance between the first bonding surface and the separation zone, and

$C_O(x)$ and $C_{O/Ref}$ are in atomic percent.

7. The method of Claim 1 or 2 wherein the movement of the positive ions during step (C) forms a region which is depleted in positive ions (the positive ion depletion region) which begins at the second bonding surface and extends into the second substrate towards the second force-applying surface.

8. The method of Claim 7 wherein:

(i) the oxide glass or oxide glass-ceramic comprises one or more of the following positive ions: $Li^{+1}$, $Na^{+1}$, $K^{+1}$, $Cs^{+1}$, $Mg^{+2}$, $Ca^{+2}$, $Sr^{+2}$, and/or $Ba^{+2}$ (the alkali/alkaline-earth ions); and

(ii) the positive ion depletion region is depleted of one or more of said alkali/alkaline-earth ions.

9. The method of Claim 8 wherein:

(i) each of the alkali/alkaline-earth ions which the oxide glass or oxide glass-ceramic contains has a reference concentration $C_{i/Ref}$ at a reference surface which 1) is within the second substrate, 2) is substantially parallel to the second bonding surface, and 3) is spaced from that surface by a distance $D_2/2$; and

(ii) the positive ion depletion region has a thickness $\delta_D$ which satisfies the relationship:

$$\delta_D \geq 10 \text{ nanometers},$$

where $\delta_D$ is the distance between the second bonding surface and a surface which 1) is within the second substrate, 2) is substantially parallel to the second bonding surface, and 3) is the surface farthest from the second bonding surface for which the following relationship is satisfied for at least one of the alkali/alkaline-earth ions which the oxide glass or oxide glass-ceramic contains:

$$C_i(x)/C_{i/Ref} \leq 0.5, \quad 0 \leq x \leq \delta_D,$$

where:

$C_i(x)$ is the concentration of said at least one alkali/alkaline-earth ion as a function of distance x from the second bonding surface, and

$C_i(x)$ and $C_{i/Ref}$ are in atomic percent.

10. The method of Claim 9 wherein:

$\delta_D \geq 1000$ nanometers.

11. The method of Claim 9 wherein the positive ion depletion region has a distal edge and the movement of the positive ions during step (C) forms a region in the vicinity of said distal edge (the pile-up region) in which the concentration of at least one type of positive ion is enhanced relative to $C_{i/Ref}$ for that ion.

12. The method of Claim 1 or 2 wherein the substantially single-crystal semiconductor material is a silicon-based material.

13. The method of Claim 1 or 2 wherein the substantially single-crystal semiconductor material comprises silicon and germanium.

14. The method of Claim 1 or 2 wherein the substantially single-crystal semiconductor material comprises silicon and carbon.

15. The method of Claim 1 or 2 wherein the separation zone is formed by hydrogen ion implantation.

16. The method of Claim 1 or 2 wherein the second part has a thickness $D_S$ which satisfies the relationship:

$D_S < 10$ microns.

17. The method of Claim 1 or 2 wherein the second part has a thickness $D_S$ which satisfies the relationship:

10 nanometers $\leq D_S \leq$ 500 nanometers.

18. The method of Claim 1 or 2 wherein step (C) is performed in an evacuated chamber.

19. The method of Claim 18 wherein the pressure in the chamber is less than or equal to one millibar.

20. The method of Claim 1 or 2 wherein step (C) is performed in an inert atmosphere.

21. The method of Claim 1 or 2 wherein step (C) is performed for a period of time which is less than or equal to 30 minutes.

22. The method of Claim 1 or 2 wherein in step (C)(1), the force per unit area P applied to the first and second force-applying surfaces satisfies the relationship:

$$1 \text{ psi} \leq P \leq 100 \text{ psi}.$$

23. The method of Claim 22 wherein:

$$1 \text{ psi} \leq P \leq 50 \text{ psi}.$$

24. The method of Claim 1 or 2 wherein $V_1$ and $V_2$ satisfy the relationship:

$$100 \text{ volts/cm} \leq (V_1 - V_2)/D \leq 40 \text{ kilovolts/cm},$$

where D is the distance between the first and second force-applying surfaces during step (C).

25. The method of Claim 1 or 2 wherein the oxide glass' or oxide glass-ceramic's strain point $T_s$ and $T_1$ and $T_2$ are in degrees centigrade and satisfy the relationships:

(i) $T_s - 350 \leq T_1 \leq T_s + 350$; and

(ii) $T_s - 350 \leq T_2 \leq T_s + 350$.

26. The method of Claim 1 or 2 wherein:

(i) $300°C \leq T_1 \leq 800°C$; and

(ii) $300°C \leq T_2 \leq 800°C$.

27. The method of Claim 1 or 2 wherein:

(i) $300°C \leq T_1 \leq 1000°C$; and

(ii) $300°C \leq T_2 \leq 1000°C$.

28. The method of Claim 1 or 2 wherein $T_2 > T_1$.

29. The method of Claim 28 wherein:

$$5°C \leq T_2 - T_1 \leq 150°C.$$

30. The method of Claim 1 or 2 wherein:

$$CTE_1 - 20x10^{-7}/°C \leq CTE_2 \leq CTE_1 + 20x10^{-7}/°C$$

where $CTE_1$ is the 0°C coefficient of thermal expansion of the substantially single-crystal semiconductor material and $CTE_2$ is the 0-300°C coefficient of thermal expansion of the oxide glass or oxide glass-ceramic.

31. The method of Claim 1 or 2 wherein the first and second force-applying surfaces are heated to $T_1$ and $T_2$, respectively, prior to step (B).

32. The method of Claim 1 or 2 wherein prior to step (A), recesses are formed in the first substrate, said recesses beginning at the first bonding surface and extending from that

surface into the body of the first substrate so as to divide the first bonding surface into substantially isolated regions which can expand and contract relatively independently of one another.

33. The method of Claim 32 wherein the recesses have a depth greater than the thickness $D_S$ of the second part.

34. The method of Claim 32 wherein the recesses are formed before the separation zone is formed.

35. The method of Claim 1 or 2 wherein the oxide glass or oxide glass-ceramic is transparent.

36. The method of Claim 1 or 2 wherein the oxide glass or oxide glass-ceramic is silica-based.

37. The method of Claim 1 or 2 wherein the oxide glass or oxide glass-ceramic comprises alkaline-earth ions and prior to step (A), at least the first bonding surface of the first substrate is treated to reduce its hydrogen concentration.

38. The method of Claim 37 wherein the treatment is an oxygen plasma treatment.

39. The method of Claim 37 wherein the treatment causes the first bonding surface to be hydrophilic.

40. The method of Claim 39 wherein the treatment causes the first bonding surface to have a water drop contact angle which is less than or equal to 10°.

41. The method of Claim 1 or 2 wherein the second substrate has a thickness $D_2$ which is greater than or equal to 1 micron.

42. The method of Claim 1 or 2 wherein the bond strength between the first and second bonding surfaces after step (D) is at least 8 joules/meter$^2$.

43. The method of Claim 1 or 2 wherein the bond strength between the first and second bonding surfaces after step (D) is at least 10 joules/meter$^2$.

44. The method of Claim 1 or 2 wherein the bond strength between the first and second bonding surfaces after step (D) is at least 15 joules/meter$^2$.

45. The method of Claim 1 or 2 wherein the sum of the concentrations of lithium, sodium, and potassium ions in the oxide glass or oxide glass-ceramic on an oxide basis is less than 1.0 weight percent and the first substrate has a maximum dimension greater than 10 centimeters.

46. The method of Claim 45 wherein the sum of the concentrations of lithium, sodium, and potassium ions in the oxide glass or oxide glass-ceramic on an oxide basis is less than 0.1 weight percent.

47. The method of Claim 1 or 2 comprising repeating steps (B) through (D) at least one additional time using at least one additional first substrate to form at least one additional second part bonded to the second substrate.

48. The method of Claim 47 wherein at least one of the second parts differs from at least one other of the second parts in at least one of thickness, surface area, or composition.

49. The method of Claim 47 wherein an edge of at least one of the second parts contacts an edge of at least one other of the second parts.

50. The method of Claim 47 wherein at least one of the second parts is spaced from at least one other of the second parts.

51. The method of Claim 47 wherein the second parts have surface areas $A_i$ which satisfy the relationship:

$$\sum_{i=1}^{N} A_i > A_T, \ N > 1,$$

where $A_T$ = 750 centimeters$^2$ if any of the second parts has a circular perimeter and $A_T$ = 500 centimeters$^2$ if none of the second parts has a circular perimeter.

52. The method of Claim 1 or 2 wherein steps (A) through (D) are performed using at least two first substrates to provide at least two second parts bonded to the second substrate.

53. The method of Claim 52 wherein at least two of the first substrates have abutting machined edges.

54. The method of Claim 52 wherein said at least two first substrates are affixed to a conductive support.

55. The method of Claim 54 wherein after said at least two first substrates are affixed to a conductive support, at least one space between the first substrates is filled with a semiconductor material.

56. The method of Claim 54 wherein said at least two first substrates are hydrogen ion implanted after being affixed to the conductive support.

57. The method of Claim 52 wherein at least one of the second parts differs from at least one other of the second parts in at least one of thickness, surface area, or composition.

58. The method of Claim 52 wherein an edge of at least one of the second parts contacts an edge of at least one other of the second parts.

59. The method of Claim 52 wherein at least one of the second parts is spaced from at least one other of the second parts.

60. The method of Claim 52 wherein the second parts have surface areas $A_i$ which satisfy the relationship:

$$\sum_{i=1}^{N} A_i > A_T, \ N > 1,$$

where $A_T = 750$ centimeters$^2$ if any of the second parts has a circular perimeter and $A_T = 500$ centimeters$^2$ if none of the second parts has a circular perimeter.

61. The method of Claim 1 or 2 wherein the area of the second substrate is greater than 750 centimeters$^2$.

62. The method of Claim 1 or 2 further comprising attaching an amorphous or polycrystalline semiconductor material to the second substrate.

63. The method of Claim 62 wherein the amorphous or polycrystalline semiconductor material is attached to the second substrate prior to step (A).

64. The method of Claim 62 wherein the amorphous or polycrystalline semiconductor material is attached to the second substrate after step (D).

65. The method of Claim 1 or 2 comprising the additional steps of producing a thin film transistor using the semiconductor-on-insulator structure produced by steps (A) through (D).

66. A semiconductor-on-insulator structure comprising first and second layers which are attached to one another either directly or through one or more intermediate layers, wherein:

(a) the first layer comprises a substantially single-crystal semiconductor material;

(b) the second layer comprises an oxide glass or an oxide glass-ceramic; and

(c) the bond strength between the first and second layers is at least 8 joules/meter$^2$.

67. The semiconductor-on-insulator structure of Claim 66 wherein the bond strength between the first and second layers is at least 10 joules/meter$^2$.

68. The semiconductor-on-insulator structure of Claim 66 wherein the bond strength between the first and second layers is at least 15 joules/meter$^2$.

69. A semiconductor-on-insulator structure comprising first and second layers which are attached to one another either directly or through one or more intermediate layers, wherein:

(a) the first layer:

(i) comprises a substantially single-crystal semiconductor material;

(ii) has first and second substantially parallel faces separated by a distance $D_S$, the first face being closer to the second layer than the second face;

(iii) has a reference surface which 1) is within the first layer, 2) is substantially parallel to the first face, and 3) is separated from that face by a distance $D_S/2$; and

(iv) has a region of enhanced oxygen concentration which begins at the first face and extends towards the second face, said region having a thickness $\delta_H$ which satisfies the relationship:

$$\delta_H \leq 200 \text{ nanometers},$$

where $\delta_H$ is the distance between the first face and a surface which 1) is within the first layer, 2) is substantially parallel to the first face, and 3) is the surface farthest from the first face for which the following relationship is satisfied:

$$C_O(x) - C_{O/Ref} \geq 50 \text{ percent}, \quad 0 \leq x \leq \delta_H,$$

where:

$C_O(x)$ is the concentration of oxygen as a function of distance x from the first face,

$C_{O/Ref}$ is the concentration of oxygen at the reference surface, and

$C_O(x)$ and $C_{O/Ref}$ are in atomic percent; and

(b) the second layer comprises an oxide glass or an oxide glass-ceramic.

70. A semiconductor-on-insulator structure comprising first and second layers which are attached to one another either directly or through one or more intermediate layers, wherein:

(a) the first layer comprises a substantially single-crystal semiconductor material, said layer having a surface farthest from the second layer which is an exfoliation surface; and

(b) the second layer:

(i) has first and second substantially parallel faces separated by a distance $D_2$, the first face being closer to the first layer than the second face;

(ii) has a reference surface which 1) is within the second layer, 2) is substantially parallel to the first face, and 3) is separated from that face by a distance $D_2/2$;

(iii) comprises an oxide glass or an oxide glass-ceramic which comprises positive ions of one or more types, each type of positive ion having a reference concentration $C_{i/Ref}$ at the reference surface; and

(iv) has a region which begins at the first face and extends towards the reference surface in which the concentration of at least one type of positive ion is depleted relative to the reference concentration $C_{i/Ref}$ for that ion (the positive ion depletion region).

71. A semiconductor-on-insulator structure comprising first and second layers which are attached to one another either directly or through one or more intermediate layers, wherein:

(a) the first layer comprises a substantially single-crystal semiconductor material, said layer having a thickness of less than 10 microns; and

(b) the second layer:

(i) has first and second substantially parallel faces separated by a distance $D_2$, the first face being closer to the first layer than the second face;

(ii) has a reference surface which 1) is within the second layer, 2) is substantially parallel to the first face, and 3) is separated from that face by a distance $D_2/2$;

(iii) comprises an oxide glass or an oxide glass-ceramic which comprises positive ions of one or more types, each type of positive ion having a reference concentration $C_{i/Ref}$ at the reference surface; and

(iv) has a region which begins at the first face and extends towards the reference surface in which the concentration of at least one type of positive ion is depleted relative to the reference concentration $C_{i/Ref}$ for that ion (the positive ion depletion region).

72. A semiconductor-on-insulator structure comprising first and second layers which are attached to one another either directly or through one or more intermediate layers, wherein:

(a) the first layer (i) comprises a substantially single-crystal semiconductor material and (ii) has a maximum dimension greater than 10 centimeters; and

(b) the second layer comprises an oxide glass or an oxide glass-ceramic which comprises positive ions of one or more types, wherein the sum of the concentrations of

lithium, sodium, and potassium ions in the oxide glass or oxide glass-ceramic on an oxide basis is less than 1.0 weight percent.

73. The semiconductor-on-insulator structure of Claim 72 wherein the sum of the concentrations of lithium, sodium, and potassium ions in the oxide glass or oxide glass-ceramic on an oxide basis is less than 0.1 weight percent.

74. A semiconductor-on-insulator structure comprising first and second layers which are attached to one another either directly or through one or more intermediate layers, wherein:

(a) the first layer comprises a substantially single-crystal semiconductor material; and

(b) the second layer:

(i) has first and second substantially parallel faces separated by a distance $D_2$, the first face being closer to the first layer than the second face;

(ii) has a reference surface which 1) is within the second layer, 2) is substantially parallel to the first face, and 3) is separated from that face by a distance $D_2/2$;

(iii) comprises an oxide glass or an oxide glass-ceramic which comprises positive ions of one or more types, each type of positive ion having a reference concentration $C_{i/Ref}$ at the reference surface;

(iv) has a region which begins at the first face and extends towards the reference surface in which the concentration of at least one type of positive ion is depleted relative to the reference concentration $C_{i/Ref}$ for that ion (the positive ion depletion region), said region having a distal edge; and

(v) has a region in the vicinity of said distal edge in which the concentration of at least one type of positive ion is enhanced relative to $C_{i/Ref}$ for that ion (the pile-up region).

75. The semiconductor-on-insulator structure of Claim 74 wherein the at least one type of positive ion has a peak concentration $C_{i/Peak}$ in the pile-up region which satisfies the relationship:

$$C_{i/Peak}/C_{i/Ref} \geq 1,$$

where $C_{i/Peak}$ and $C_{i/Ref}$ are in atomic percent.

76. A semiconductor-on-insulator structure comprising first and second layers which are attached to one another either directly or through one or more intermediate layers

with a bond strength of at least 8 joules/meter$^2$, said first layer comprising a substantially single-crystal semiconductor material and said second layer comprising an oxide glass or an oxide glass-ceramic wherein at least a portion of the first layer proximal to the second layer comprises recesses which divide said portion into substantially isolated regions which can expand and contract relatively independently of one another.

77. The semiconductor-on-insulator structure of Claim 76 wherein the recesses extend through the entire thickness of the first layer.

78. The semiconductor-on-insulator structure of Claim 76 or 77 wherein the bond strength between the first and second layers is at least 10 joules/meter$^2$.

79. The semiconductor-on-insulator structure of Claim 76 or 77 wherein the bond strength between the first and second layers is at least 15 joules/meter$^2$.

80. The semiconductor-on-insulator structure of Claim 76 or 77 wherein the oxide glass or oxide glass-ceramic has a 0-300°C coefficient of thermal expansion which is greater than the 0°C coefficient of thermal expansion of the substantially single-crystal semiconductor material.

81. The semiconductor-on-insulator structure of Claim 66, 69, 70, 71, 72, 74, or 76 wherein the oxide glass or the oxide glass-ceramic of the second layer:

(a) has a 0-300°C coefficient of thermal expansion CTE and a 250°C resistivity ρ which satisfy the relationships:

$$5\times10^{-7}/°C \leq CTE \leq 75\times10^{-7}/°C, \text{ and}$$

$$\rho \leq 10^{16}\ \Omega\text{-cm};$$

(b) has a strain point $T_s$ of less than 1,000°C; and

(c) comprises positive ions whose distribution within the oxide glass or oxide glass-ceramic can be altered by an electric field when the temperature T of the oxide glass or oxide glass-ceramic satisfies the relationship:

$$T_s - 350 \leq T \leq T_s + 350,$$

where $T_s$ and T are in degrees centigrade.

82. The semiconductor-on-insulator structure of Claim 69, 70, 71, 72, or 74 wherein the bond strength between the first and second layers is at least 8 joules/meter$^2$.

83. The semiconductor-on-insulator structure of Claim 70, 71, 72, 74, or 76 wherein the first layer:

(i) has first and second substantially parallel faces separated by a distance $D_S$, the first face of the first layer being closer to the second layer than the second face of the first layer;

(ii) has a first layer reference surface which 1) is within the first layer, 2) is substantially parallel to the first face of the first layer, and 3) is separated from that face by a distance $D_S/2$; and

(iii) has a region of enhanced oxygen concentration which begins at the first face of the first layer and extends towards the second face of the first layer, said region having a thickness $\delta_H$ which satisfies the relationship:

$$\delta_H \leq 200 \text{ nanometers},$$

where $\delta_H$ is the distance between the first face of the first layer and a surface which 1) is within the first layer, 2) is substantially parallel to the first face of the first layer, and 3) is the surface farthest from the first face of the first layer for which the following relationship is satisfied:

$$C_O(x) - C_{O/Ref} \geq 50 \text{ percent}, \quad 0 \leq x \leq \delta_H,$$

where:

$C_O(x)$ is the concentration of oxygen as a function of distance x from the first face of the first layer,

$C_{O/Ref}$ is the concentration of oxygen at the first layer reference surface, and

$C_O(x)$ and $C_{O/Ref}$ are in atomic percent.

84. The semiconductor-on-insulator structure of Claim 71, 72, 74, or 76 wherein the first layer has a surface farthest from the second layer which is an exfoliation surface.

85. The semiconductor-on-insulator structure of Claim 72, 74, or 76 wherein the first layer has a thickness of less than 10 microns.

86. The semiconductor-on-insulator structure of Claim 74 or 76 wherein:

(a) the first layer has a maximum dimension greater than 10 centimeters; and

(b) the second layer comprises an oxide glass or an oxide glass-ceramic which comprises positive ions of one or more types, wherein the sum of the concentrations of lithium, sodium, and potassium ions in the oxide glass or oxide glass-ceramic on an oxide basis is less than 1.0 weight percent.

87. The semiconductor-on-insulator structure of Claim 86 wherein the sum of the concentrations of lithium, sodium, and potassium ions in the oxide glass or oxide glass-ceramic on an oxide basis is less than 0.1 weight percent.

88. The semiconductor-on-insulator structure of Claim 76 wherein the second layer:

(i) has first and second substantially parallel faces separated by a distance $D_2$, the first face being closer to the first layer than the second face;

(ii) has a reference surface which 1) is within the second layer, 2) is substantially parallel to the first face, and 3) is separated from that face by a distance $D_2/2$;

(iii) comprises an oxide glass or an oxide glass-ceramic which comprises positive ions of one or more types, each type of positive ion having a reference concentration $C_{i/Ref}$ at the reference surface;

(iv) has a region which begins at the first face and extends towards the reference surface in which the concentration of at least one type of positive ion is depleted relative to the reference concentration $C_{i/Ref}$ for that ion (the positive ion depletion region), said region having a distal edge; and

(v) has a region in the vicinity of said distal edge in which the concentration of at least one type of positive ion is enhanced relative to $C_{i/Ref}$ for that ion (the pile-up region).

89. The semiconductor-on-insulator structure of Claim 70, 71, or 74 wherein:

(i) the glass or glass-ceramic comprises one or more of the following positive ions: $Li^{+1}$, $Na^{+1}$, $K^{+1}$, $Cs^{+1}$, $Mg^{+2}$, $Ca^{+2}$, $Sr^{+2}$, and/or $Ba^{+2}$ (the alkali/alkaline-earth ions); and

(ii) the positive ion depletion region is depleted of at least one of said alkali/alkaline-earth ions.

90. The semiconductor-on-insulator structure of Claim 89 wherein the positive ion depletion region has a thickness $\delta_D$ which satisfies the relationship:

$$\delta_D \geq 10 \text{ nanometers},$$

where $\delta_D$ is the distance between the first face of the second layer and a surface which 1) is within the second layer, 2) is substantially parallel to the first face of the second layer, and 3) is the surface farthest from the first face of the second layer for which the following relationship is satisfied for at least one of the alkali/alkaline-earth ions which the glass or glass-ceramic contains:

$$C_i(x)/C_{i/Ref} \leq 0.5, \quad 0 \leq x \leq \delta_D,$$

where:

$C_i(x)$ is the concentration of said at least one alkali/alkaline-earth ion as a function of distance x from the first face of the second layer, and

$C_i(x)$ and $C_{i/Ref}$ are in atomic percent.

91. The semiconductor-on-insulator structure of Claim 90 wherein:

$\delta_D \geq 1000$ nanometers.

92. The semiconductor-on-insulator structure of Claim 66, 69, 70, 71, 72, 74, or 76 wherein the first layer has a thickness $D_S$ which satisfies the relationship:

10 nanometers $\leq D_S \leq$ 500 nanometers.

93. The semiconductor-on-insulator structure of Claim 66, 69, 70, 71, 72, 74, or 76 wherein the first and second layers are directly attached to one another.

94. The semiconductor-on-insulator structure of Claim 66, 69, 70, 71, 72, 74, or 76 wherein the second layer is transparent.

95. The semiconductor-on-insulator structure of Claim 66, 69, 70, 71, 72, 74, or 76 wherein the second layer has a thickness $D_2$ which is greater than or equal to 1 micron.

96. The semiconductor-on-insulator structure of Claim 66, 69, 70, 71, 72, 74, or 76 further comprising an amorphous or polycrystalline semiconductor material attached to the second layer.

97. A semiconductor-on-insulator structure comprising a substantially single-crystal semiconductor material (material S) and an oxide glass or an oxide glass-ceramic which comprises positive ions (material G), wherein at least a part of the structure comprises in order:

material S;

material S with an enhanced oxygen content;

material G with a reduced positive ion concentration for at least one type of positive ion;

material G with an enhanced positive ion concentration for at least one type of positive ion; and

material G.

98. The semiconductor-on-insulator structure of Claim 97 wherein the at least one type of positive ion comprises an alkali ion.

99. The semiconductor-on-insulator structure of Claim 97 wherein the at least one type of positive ion comprises an alkaline-earth ion.

100. The semiconductor-on-insulator structure of Claim 97 wherein the oxide glass or oxide glass-ceramic has a 0-300°C coefficient of thermal expansion CTE and a 250°C resistivity ρ which satisfy the relationships:

$$5\times10^{-7}/°C \le CTE \le 75\times10^{-7}/°C, \text{ and}$$

$$\rho \le 10^{16}\ \Omega\text{-cm},$$

said oxide glass or oxide glass-ceramic having a strain point of less than 1,000°C.

101. The semiconductor-on-insulator structure of Claim 97 wherein the surface of material S farthest from material G is an exfoliation surface.

102. The semiconductor-on-insulator structure of Claim 97 wherein the thickness of material S is less than 10 microns.

103. The semiconductor-on-insulator structure of Claim 97 wherein the bond strength between material S and material G is at least 8 joules/meter$^2$.

104. The semiconductor-on-insulator structure of Claim 97 wherein the sum of the concentrations of lithium, sodium, and potassium ions in material G is less than 1.0 weight percent and material S has a maximum dimension greater than 10 centimeters.

105. The semiconductor-on-insulator structure of Claim 104 wherein the sum of the concentrations of lithium, sodium, and potassium ions in material G is less than 0.1 weight percent.

106. The semiconductor-on-insulator structure of Claim 97 wherein material G is transparent.

107. The semiconductor-on-insulator structure of Claim 97 further comprising an amorphous or polycrystalline semiconductor material attached to material G.

108. The semiconductor-on-insulator structure of Claim 66, 69, 70, 71, 72, 74, 76, or 97 wherein the substantially single-crystal semiconductor material is a silicon-based material.

109. The semiconductor-on-insulator structure of Claim 66, 69, 70, 71, 72, 74, 76, or 97 wherein the substantially single-crystal semiconductor material comprises silicon and germanium.

110. The semiconductor-on-insulator structure of Claim 66, 69, 70, 71, 72, 74, 76, or 97 wherein the substantially single-crystal semiconductor material comprises silicon and carbon.

111. The semiconductor-on-insulator structure of Claim 66, 69, 70, 71, 72, 74, 76, or 97 wherein:

$$CTE_1 - 20x10^{-7}/°C \leq CTE_2 \leq CTE_1 + 20x10^{-7}/°C$$

where $CTE_1$ is the 0°C coefficient of thermal expansion of the substantially single-crystal semiconductor material and $CTE_2$ is the 0-300°C coefficient of thermal expansion of the oxide glass or oxide glass-ceramic.

112. The semiconductor-on-insulator structure of Claim 66, 69, 70, 71, 72, 74, 76, or 97 wherein the oxide glass or oxide glass-ceramic is silica-based.

113. A silicon-on-insulator structure comprising first and second layers which are directly attached to one another, said first layer comprising a substantially single-crystal silicon material and said second layer comprising a glass or a glass-ceramic which comprises silica and one or more other oxides as network formers, said first layer comprising a region which contacts the second layer and comprises silicon oxide but does not comprise the one or more other oxides, said region having a thickness which is less than or equal to 200 nanometers.

114. The silicon-on-insulator structure of Claim 113 wherein at least one of the one or more other oxides which are network formers is selected from the group consisting of $B_2O_3$, $Al_2O_3$, and $P_2O_5$.

115. The silicon-on-insulator structure of Claim 113 wherein the substantially single-crystal silicon material comprises silicon and germanium.

116. The silicon-on-insulator structure of Claim 113 wherein the substantially single-crystal silicon material comprises silicon and carbon.

117. The silicon-on-insulator structure of Claim 113 wherein the second layer is transparent.

118. The silicon-on-insulator structure of Claim 113 wherein the second layer has a thickness $D_2$ which is greater than or equal to 1 micron.

119. The silicon-on-insulator structure of Claim 113 wherein the bond strength between the first and second layers is at least 8 joules/meter$^2$.

120. The semiconductor-on-insulator structure of Claim 113 wherein the first layer has a surface farthest from the second layer which is an exfoliation surface.

121. A semiconductor-on-insulator structure comprising first and second layers which are attached to one another either directly or through one or more intermediate layers, wherein:

(a) the first layer comprises a plurality of regions each of which comprises a substantially single-crystal semiconductor material;

(b) the second layer comprises an oxide glass or an oxide glass-ceramic; and

(c) the regions have surface areas $A_i$ which satisfy the relationship:

$$\sum_{i=1}^{N} A_i > A_T, \ N > 1,$$

where $A_T$ = 750 centimeters$^2$ if any of the regions has a circular perimeter and $A_T$ = 500 centimeters$^2$ if none of the regions has a circular perimeter.

122. The semiconductor-on-insulator structure of Claim 121 wherein an edge of at least one of the regions contacts an edge of at least one other of the regions.

123. The semiconductor-on-insulator structure of Claim 121 wherein at least one of the regions is spaced from at least one other of the regions.

124. The semiconductor-on-insulator structure of Claim 121 wherein at least one of the regions differs from at least one other of the regions in at least one of thickness, surface area, or composition.

125. The semiconductor-on-insulator structure of Claim 121 further comprising an amorphous or polycrystalline semiconductor material attached to the second layer.

126. The semiconductor-on-insulator structure of Claim 121 wherein the area of the second layer is greater than 750 centimeters$^2$.

127. A liquid crystal display comprising the semiconductor-on-insulator structure of Claim 66, 69, 70, 71, 72, 74, 76, 97 or 121.

128. A liquid crystal display comprising the silicon-on-insulator structure of Claim 113.